

ESD ADV1.0-2009

ESD Association Advisory

ESD ADV1.0-2009
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*for Electrostatic Discharge
Terminology*

Glossary



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7900 Turin Road, Bldg. 3
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ESD Association



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ESD Association Advisory for Electrostatic Discharge Terminology – Glossary

1.0 PURPOSE

The purpose of this Glossary is to promote technically correct terminology in the electrical overstress/electrostatic discharge (EOS/ESD) community.

2.0 SCOPE

This document contains unified definitions and explanations of terminology used in the standards, TR20.20 Handbook, and other documents of the ESD Association. The Glossary compares EOS/ESD industry terminology with the more familiar usages of electrical and electronic terms. Although the Glossary is not intended to be an encyclopedia, it includes historical information (including explanations of obsolete terminology) and clarifies terminology in other EOS/ESD-related documents.

The Glossary is revised as needed so that it evolves continually along with the evolving knowledge of EOS/ESD phenomena and protective methods.

New revisions of the Glossary cover all issued standards, standard practices, standard test methods in effect at the time the revision, but not necessarily draft documents. At the time of each edition's publication, the Glossary includes the most recent updates of the definitions from all issued ESD Association standards.

3.0 DEFINITIONS

AC equipment ground

- a) The ground point at which the equipment grounding conductor is bonded to any piece of equipment, at the equipment end of the conductor in a single-phase 120VAC electrical service.
- b) The 3rd wire (green/green with yellow stripe) terminal of a receptacle.
NOTE: Wiring colors may vary by National Electrical Code.
- c) The entire low impedance path (electrically equivalent to the equipment grounding conductor) from a piece of electrical equipment to the neutral bus at the main service equipment).

acceptance equipment

An instrument or collection of instruments that meet the criteria of a standard or standard test method and provides a measurement that is repeatable. It may or may not be as accurate as laboratory evaluation equipment. This equipment is typically used to verify materials, devices or procedures under in-use conditions.

acceptance testing

Incoming tests to confirm proper marking and electrical functionality. Data are the form of visual inspection records, and values or pass/fail notation.

active components

Semiconductor devices and elements such as transistors and diodes that can change their basic characteristics in a powered electrical circuit, such as amplifiers and rectifiers.

air conductivity

The ability of air to conduct (pass) an electric current under the influence of an electric field.

air ions

Molecular clusters of about 10 molecules (water, impurities, etc.) bound by polarization forces to a singly charged oxygen or nitrogen molecule.

air ionizer

A source of charged air molecules (ions).

amplitude

The value chosen to be specific to the waveform, typically the difference between the baseline and the first peak.

ankle strap

See ground strap.

antistat, agent

A substance that is part of or topically applied to a material to render the material surface static dissipative or less susceptible to triboelectric charging.

antistatic

Usually refers to the property of a material that inhibits triboelectric charging. Note: A material's antistatic characteristic is not necessarily co-relatable with its resistivity or resistance.

attenuator

A resistive network with coaxial connectors to reduce the amplitude of a signal by a specified amount.

automated handling equipment (AHE)

Any form of self-sequencing machinery that manipulates or transports product in any form; e.g. wafers, packaged devices, paper, textiles, etc.

auxiliary ground

A separate supplemental grounding conductor for use other than general equipment grounding.

bandwidth

The high frequency limit where the amplitude of a component of system has decreased to 0.707 (-3 dB) of the constant amplitude low frequency response.

barrier strip

A device or apparatus that consists of a metal strip and connectors or screws that allow termination and connection of wires or conductors from various components of an electrostatic discharge protected workstation.

bipolar ionizer

A device that generates both positively and negatively charged ions.

body contacting mechanism (BCM)

The part of the foot grounder that makes electrical contact with the body.

bond or bonding

The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to safely conduct any current likely to be imposed.

bonding conductor

The wire, strap, flange or other electrically conductive mechanical device used to interconnect two otherwise isolated conductive or dissipative items.

breakaway force

The force required to disconnect the ground cord from the cuff.

bus bar

A metal strip or bar to which several conductors may be bonded.

bypass capacitor

A capacitor placed between power and ground to provide a more stable power supply voltage by shunting high frequency signals (such as device switching noise) and/or to provide local power storage (to reduce supply voltage variations when device current usage changes).

cable discharge current

A current produced by causing a stored charge to flow in or out of a cable conductor.

cable discharge event

Occurrence of an Electrostatic Discharge Event (CDE) when the cable is connected to an electrical system or equipment. Examples of sources include Ethernet cables, T1 lines and other communications or data lines.

charge decay

The decrease and/or neutralization of a net electrostatic charge.

charge induction

The displacement of charge in an isolated conductor when placed in an electric field (for example, from a charged body). Note: Momentary grounding of such a conductor would result in its gaining a net charge.

charged device model (CDM) electrostatic discharge (ESD)

An ESD stress model that approximates the discharge event that occurs when a charged component is quickly discharged to another object at a lower electrostatic potential through a signal pin or terminal.

charged device model (CDM) electrostatic discharge (ESD) tester

Equipment that simulates the component level CDM ESD event using the non-socketed test method.

charged plate monitor (CPM)

An instrument used to measure the charge neutralization properties of ionization equipment.

coaxial resistive probe

A resistor (1.0 ohm example) used to measure the CDM discharge current.

coaxial transmission line

A coaxial cable with controlled impedance used for transferring a signal with minimum loss from one point of the system to another.

cold healing

The spontaneous recovery, at room temperature, of an item from a parametric change caused by electrostatic discharge.

cold workstation

A work area that has items, assemblies, black boxes, or systems which no power is applied.

common connection point

A device or location (less than 1 ohm within itself) where the conductors of two or more ESD technical elements are connected in order to bring the ungrounded ESD technical elements to the same electrical potential through equipotential bonding.

common point ground

A grounded device or location where the conductors of one or more technical elements are bonded.

compliance (periodic) verification

Testing done to indicate that the performance has not changed from initial baseline values to exceed selected limits.

compliance verification (periodic testing) equipment

An instrument or collection of instruments that provide an indication or measurement. It may or may not be repeatable or accurate. This equipment is typically used for indications of pass or fail.

component

An active or passive item such as a resistor, diode, transistor, integrated circuit or hybrid circuit.

component failure

A condition in which a tested component does not meet one or more specified static or dynamic data sheet parameters.

component under test (CUT)

A passive or active element, device, integrated circuit, module or subsystem being tested. The CUT is intended to become part of a completed system but is not the entire system.

compressed gas ionizer

Ionization devices that can be used to neutralize charged surfaces and / or remove surface particles with pressurized gas. This type of ionizer may be used to ionize the gas within production equipment.

conductive flooring material

A floor material that has a resistance to ground of less than 1.0×10^6 ohms.

conductive material, resistance

A material that has a surface resistance of less than 1×10^4 ohms or a volume resistance of less than 1×10^4 ohms.

conductive material, resistivity

A material that has a surface resistivity less than 1×10^5 ohms/square or a volume resistivity less than 1×10^4 ohm-cm.

conductivity

- a. The ratio of the current per unit area (current density) to the electric field in a material. Conductivity is expressed in units of siemens/meter.
- b. In non-technical usage, the ability to conduct current.

constant area and force electrode (CAFÉ)

An electrode designed to be held by a person's finger, gloved or ungloved, to reproducibly measure resistance from the finger to a counter electrode such as a ground strap worn on the wrist of the same hand. This electrode is suitable for measuring the resistance of a finger wearing a finger cot.

contact-mode discharge

An ESD event initiated within a relay. The relay is connected to the component pin via a probe, and the component is not in a socket.

contact-mode, non-socketed discharge

See constant-mode discharge.

corona

The production of positive and negative ions by a very localized high electric field. The field is normally established by applying a high voltage to a conductor in the shape of a sharp point or wire.

correlation sample

A representative device used for correlating measured voltages with known applied voltages.

critical path components

Any portion of the AHE within a certain distance of the device path. That distance should be agreed upon between the manufacturer and end user.

cuff

The portion of the wrist strap worn on the wrist. The cuff maintains electrical contact with a person's skin.

current limiting resistance

A resistance value incorporated in series with the wrist strap or foot grounder's electrical path to ground. This resistance limits electrical current that could pass through the grounding mechanism in the event of inadvertent user contact with electrical potential.

current sense resistor

A resistor, R_{CS} , of less than five ohms which produces a measurable voltage proportional to current through it with an intrinsic rise-time response three times faster than the fastest rise-time to be measured. $\Delta v = \Delta i \times R_{CS}$.

current sensor

A device used to measure the current in a circuit or system. This device could be non-invasive (by sensing the change in magnetic flux lines) or be very low impedance inserted in series (such as the ESD target).

current source method

A TLP methodology (sometimes referred to as constant current method) that utilizes a 500 ohm resistor in series with the DUT and measures the voltage and current at the DUT.

data sheet parameters

Static and dynamic component performance data supplied by the component manufacturer or user.

DC resistance

The ratio of the DC voltage applied to a conductor to the CD current through it.

decay rate

The decrease of charge or voltage per unit time.

decay time

The time required for an electrostatic potential to be reduced to a given percentage (usually 10%) of its initial value. (See Static Decay Test.)

delay line

A transmission line used to introduce signal delay between two components of a system.

destructive damage

Damage where the operating electrical characteristics or parameters are altered and do not recover to the initial conditions prior to stress.

device

Product being processed by AHE (e.g., an integrated circuit [IC] or a printed circuit [PC] board).

device path

The route traveled by a device in an AHE.

device under test (DUT)

The device to which the Transient Stimulus will be applied.

di/dt

Current derivative: the slope of the tangent at a particular point in time of the current signal.

dielectric

An insulating material that can sustain an electric field with little current flow.

dielectric breakdown voltage

The electric potential across an insulating material that causes a sudden increase in current through the material of the insulator.

dielectric strength

The maximum electric field that a dielectric can sustain.

discharge current

A current produced by causing a stored charge to flow out of a component into a conductor from an ESD simulator.

discharge time

The time necessary for a voltage (due to an electrostatic charge) to decay from an initial value to some arbitrarily chosen final value.

discrete component

An elementary electronic device constructed as a single unit such as a transistor, resistor, capacitor, inductor, diode, etc.

dissipative floor material

Floor material that has a resistance to ground between 1.0×10^6 and 1.0×10^9 ohms.

dissipative Materials

A material that has a surface resistance greater than or equal to 1×10^4 ohms but less than 1×10^{11} ohms or a volume resistance greater than or equal to 1×10^4 ohms but less than 1×10^{11} ohms.

dynamic parameters

Dynamic parameters are those measured with the component in a functioning (operating) condition. These parameters may include, but are not limited to: full functionality, output rise and fall times under a specified load condition, and dynamic current draw.

dynamic state

Any operational state where the device is functioning according to its design. Typically, inputs, I/O, and output pins are changing as a required to operate the device. In the dynamic state, the supply current should be changing throughout the range of I_{DDNOM} .

earth grounding electrode

The metal rod, metal plate, metal pipe, metal mesh, metal underground water pipe, or grounded metal building frame that are bonded to the neutral bus at the main service entrance.

electric charge

An absence or excess of electrons.

electric field shielding materials

A material that has a surface resistance or a volume resistance of less than 1×10^3 .

electrical ionizer

A device that creates ions in gases by use of high voltage electrodes.

electrical overstress (EOS)

The exposure of an item to a current or voltage beyond its maximum ratings. This exposure may or may not result in a catastrophic failure.

electrification period

The average of five (5) electrification times, plus five (5) seconds.

electrification time

The time for the resistance measuring instrument to stabilize at the value of the upper resistance range verification fixture.

electrostatic charge

Electric charge at rest.

electrostatic damage

Change to an item caused by an electrostatic discharge that makes it fail to meet one or more specified parameters.

electrostatic discharge (ESD)

The rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field. Note: Usually, the charge flows through a spark between two bodies at different electrostatic potentials as they approach one another. Details of such processes, such as the rate of the charge transfer, are described in specific electrostatic discharge models.

electrostatic discharge (ESD) control

See static control.

electrostatic discharge (ESD) ground

The point, electrodes, bus bar, metal strips, or other system of conductors that form a path from a statically charged person or object to ground.

electrostatic discharge (ESD) protective

A property of materials capable of one or more of the following: reducing the generation of static electricity, dissipating electrostatic charges over its surface or volume, or providing shielding from ESD or electrostatic fields.

electrostatic discharge (ESD) protective symbol

The graphics used to identify items that are specifically designed to provide electrostatic discharge protection.

electrostatic discharge (ESD) protective workstation

An area that is constructed and equipped with the necessary protective materials and equipment to limit damage to electrostatic discharge susceptible items handled therein.

electrostatic discharge (ESD) protective worksurface

A worksurface that dissipates electrostatic charge from materials placed on the surface or from the surface itself.

electrostatic discharge sensitivity (ESDS)

The ESD level that causes component failure. (Note: See also electrostatic discharge susceptibility.)

electrostatic discharge (ESD) shield

A barrier or enclosure that limits the passage of current and attenuates an electromagnetic field resulting from an electrostatic discharge.

electrostatic discharge (ESD) spark testing

Testing performed with operating equipment or parts to determine their susceptibility to the transient electromagnetic fields produced by an air discharge event.

electrostatic discharge susceptibility (ESDS)

The propensity to be damaged by electrostatic discharge. (See also electrostatic discharge sensitivity).

electrostatic discharge susceptibility (ESDS) classification

The classification of items according to electrostatic discharge susceptibility voltage ranges. Note: There are various classification methods.

electrostatic discharge susceptibility (ESDS) symbol

The graphics placed on hardware, assemblies, and documentation for identification of electrostatic discharge susceptible items.

electrostatic discharge susceptible (ESDS) item

Electrical or electronic piece part, device, component, assembly, or equipment item that has some level of electrostatic discharge susceptibility.

electrostatic discharge (ESD) withstand voltage

The maximum electrostatic discharge (ESD) level that does not cause component failure.

electrostatic field

An attractive or repulsive force in space due to the presence of electric charge.

electrostatic potential

The voltage difference between a point and an agreed upon reference.

electrostatic shield

A barrier or enclosure that limits the penetration of an electrostatic field.

electrostatics

The study of electrostatic charge and its effects.

emitter

A conducting sharp object, usually a needle or wire, which will cause a corona discharge when kept at a high potential.

energized

The state of a piece of equipment such that it carries electrical, fluid, thermal, mechanical or other form of energy in a state which could pose a hazard to personnel.

EOS

See electrical overstress.

equipment grounding conductor

The conductor used to connect the non-current carrying metal parts of equipment, raceways and other enclosures to the main service equipment ground bus.

equipotential

Having the same electrical potential; of uniform electrical potential throughout.

ESD

See electrostatic discharge.

ESD event

Occurrence of a single electrostatic discharge from any source. Examples of source include humans, ESD simulators and other charged objects.

ESD grounding / bonding reference point

The ESD grounding system selected for use in a facility or situation that best suits the application: a) AC equipment ground; b) auxiliary ground; c) equipotential bonding

ESD protected area (EPA)

A defined location with the necessary materials, tools and equipment capable of controlling static electricity to a level that minimizes damage to ESD susceptible items.

ESD target

A current transducer used to measure ESD discharges.

ESD target adapter

An adapter used to connect reference generators to the ESD target.

ESD technical elements

All of the items, materials, devices, tools and equipment used within an EPA for the control of static electricity.

ESDS

See Electrostatic Discharge Susceptible

evaluation testing

Stringent testing of a wrist strap to determine its electrical and mechanical performance abilities. Data are in the form of values from laboratory testing.

failure threshold current

The supply current value that when exceeded, is considered to have failed the device. To avoid false failures due to changes of state it should be greater than the nominal supply current (I_{DDNOM}).

faraday cage

A conductive enclosure that attenuates a stationary electrostatic field.

field induced charging

A charging method using electrostatic induction.

field plate (FP)

The field plate is a conductive plate used to elevate the potential of the DUT by capacitive coupling.

final test voltage

The voltage on the test plate of the periodic verification instrument at which the discharge time test ends.

floor contacting surface (FCS)

That part of the foot grounder that makes electrical contact to the grounding surface.

flooring / foot grounder system resistance

The total resistance of the foot grounders when worn by the person standing on a static floor or stainless steel plate.

foot grounder

Personnel grounding device worn on the shoe. The device makes electrical contact with the surface on which the wearer is standing. The device also makes contact with the wearer through either direct skin contact or by contacting moisture inside the shoe. This definition includes heel / toe grounders and booties or similar devices (excluding static control shoes).

foot grounder system

A foot grounder properly worn by a person where the electrical path includes the person and the foot grounder.

functional state

The functional state of the device defines the mode in which it is operating.

functional testing

End-use testing to confirm electrical functionality. Data is in the form of pass/fail notation or values.

FWHM

Full Width at Half Maximum

garment system

Any electrically interconnected components of static control apparel.

ground

- a. A conducting connection, whether intentional or accidental between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of earth.
- b. The position or portion of an electrical current at zero potential with respect to the earth.
- c. A conducting body, such as the earth of the hull of a steel ship used as a return path for electric currents and as an arbitrary zero reference point.

ground cord

The portion of the wrist strap that provides flexibility of movement while completing the electrical circuit between the cuff and ground.

ground current

The current flowing out of the ground pin.

ground fault circuit interrupter

A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time. It is activated when a current difference between the neutral and hot conductors exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit. The current difference is usually caused by a current to ground.

ground lead

The portion of the wrist strap, which provides flexibility of movement while completing the electrical circuit between the cuff at one end and a ground system at the other.

ground pin

The pin or set of pins that return current to the supply voltage source.

ground plane (GP)

A conductive plate used to complete the circuitry for grounding / discharging the DUT.

ground reference point

The prong of the equipment's ground wire from hand soldering equipment to a workstation ground point. Examples are: (a) The ground U-prong (or round prong) of an AC power cord; (b) the banana plug of a grounding patch cord; (c) the ring or spade lug of a ground jumper wire.

ground strap

- a. A conductor intended to provide an electrical path to ground.
- b. An item used by personnel with a specified resistance, intended to provide a path to ground.

groundable point

A designated connection location or assembly used on an electrostatic discharge protective material or device that is intended to accommodate electrical connection from the device to an appropriate electrical ground.

groundable point, floor material

A point on the floor material that accommodate an electrical connection from the floor material to an appropriate ground.

groundable point, seating

Conductive caster or drag chain used to provide an electrical path from seating to a static control floor or mat.

groundable static control garment

A garment that exhibits an electrical resistance less than 1×10^9 ohms from point-to-point and from any point or panel on the garment to the groundable point on the garment.

groundable static control garment system

Garments that are used to establish the primary ground path for a person shall provide a resistance of less than 35 megohms from the person to the groundable point of the garment. The garment must also meet all the requirements included in the definition for groundable static control garments.

grounded

Connected to earth or some other conducting body that serves in place of the earth.

grounded conductor

A system or circuit conductor that is intentionally grounded.

grounding conductor

A conductor used to connect equipment or the ground circuit of a wiring system to a ground electrode or electrodes.

grounding electrode conductor

A conductor used to connect the ground electrode(s) to the equipment grounding conductor, to the grounded conductor, or to both at the main service, at each building or structure where supplied from a common service, or at the source of a separately derived system.

grounding resistance

The total resistance from any given point in an electrically conductive path to the grounding electrode.

hard ground

A connection to ground through a wire or other conductor that has very little or nearly no resistance (impedance) to ground.

hardboard (standard or tempered)

Heavy sheet material of fibers matted and pressed or rolled to form a strong board.

horizontal laminar flow

Non-turbulent air flow in a horizontal direction.

hot work station

A work area that has items, assemblies, black boxes, or systems which have power applied for testing or repair.

human body model (HBM) electrostatic discharge (ESD)

An ESD stress model that approximates the discharge from the fingertip of a typical human being onto a pin of a device with another pin grounded.

human body model (HBM) electrostatic discharge (ESD) tester

Equipment that applies human body model electrostatic discharges to a component.

human metal model (HMM) electrostatic discharge (ESD) tester

An ESD stress model that approximates the discharge from a human holding a metal object, such as a screw driver, touching one pin of a device with another pin grounded.

impedance, symbol Z

The total opposition (i.e., resistance or reactance) a circuit offers to the flow of alternating current. It is measured in ohms and the lower the ohmic value, the better the quality of the conductor.

inductive charging

The transfer of an electric charge to an object when it is momentarily contacted to ground in the presence of an electric field.

initial test voltage

The voltage on the test plate of the periodic verification instrument at which the discharge time test begins.

input protection

Structures, devices or networks connected at the input terminals of an item to prevent electrostatic discharge damage.

insulated conductor

A conductor encased within material of composition and thickness that is recognized as electrical insulation.

insulative materials

A material that has a surface resistance or a volume resistance equal to or greater than 1×10^{11} ohms.

interface board

The interface board connects the top and bottom 256 pin decks of the tester together to create a single 512 pin test simulator.

in-use (system) resistance test

A system resistance test from a constant area and force electrode, through a glove or finger cot, to a person's finger or thumb, using a wrist strap as the second electrode.

ionization

The process by which a neutral atom or molecule acquires a positive or negative charge.

ionizer

A device which is designed to generate positive and/or negative air ions.

isolated conductor

A non-grounded conductor.

isolated ground

A separate equipment grounding conductor, which is only bonded to the ground bus (at the main service equipment) and a receptacle. It is permitted to pass through electrical panels, junction boxes, etc., without being bonded to the equipment grounding conductor which services those devices. An isolated ground is not to be used to derive an ESD ground.

isolated ground receptacle

A special electrical outlet that contains a separate equipment grounding conductor. The electrical receptacle is usually orange in color and has a colored triangle marked on the face of the receptacle.

junction damage

Electrical overstress damage to a semiconductor junction.

laboratory evaluation equipment

An instrument or collection of instruments that meet the criteria of a standard or standard test method that provides a measurement that is accurate and repeatable. This equipment is typically used to qualify materials, devices or procedures prior to acceptance and under controlled conditions.

laminar flow hood ionization

These devices or systems provide local area ionization coverage in vertical or horizontal laminar flow hoods or benches.

latch-up

Latch-up refers to the activation of parasitic bipolar transistors (junctions) inherent to the CMOS process. These Transistors form a latch, which when activated, results in a large and sustained increase in the supply current. This state remains active until power is removed or the device self-destructs. The device is generally non-functional when in their state. Latch-up is typically triggered by an over stress voltage or current on one or more pins.

latent failure

A malfunction that occurs following a period of normal operation.

NOTE: The failure may be attributable to an earlier electrostatic discharge event. The concept of latent failure is controversial and not totally accepted by all in the technical community.

level 2 technical elements

Any ESD technical element that is connected in series to common point ground or to a common connection point through another technical element

I_{p1} and I_{p2}

The peak current measured at the absolute maximum positive and negative of the discharge current waveform.

I_{PR}

The maximum positive peak current value measured using the 500 ohm resistor in the circuit.

I_r

The current waveform oscillation in the short circuit waveform is the peak-to-peak ringing that can occur within the first 100 ns of $I_{ps_{max}}$ and is manually measured.

machine model (MM) electrostatic discharge (ESD)

An ESD stress model that approximates the discharge to a device pin due to contact of equipment or tools such as those found in the manufacturing line. This model assumes that one pin is contacting the equipment or tool that has an electrostatic charge and another pin is grounded.

machine model (MM) electrostatic discharge (ESD) tester

Equipment that applies machine model electrostatic discharges to a component.

main bonding jumper

The connection between the grounded circuit conductor and the equipment grounding conductor at the service.

minority carrier flood

Transient stimuli with negative-going voltage components superimposed on the V_{DD} supply.

neutralize

To eliminate an electrostatic field by recombining positive and negative charges, either by conducting the charge to ground or by introducing an equal opposite charge.

new equipment

Any new or recently purchased HBM testers or simulator test equipment.

no connect (NC) pin

A package interconnect (pin or ball) that is not bonded to a bond pad.

nominal supply current (I_{DDNOM})

The range of supply currents possible under all normal operating states.

non-contact mode discharge

An air discharge ESD event that is initiated by a probe tip approaching a component pin.

nuclear ionizer

A device that creates ions usually by alpha emissions which strip electrons from gas molecules to form equal numbers of positive and negative ions in gases.

offset voltage

The observed voltage on the isolated conductive plate of a charged plate monitor that has been placed in an ionized environment.

old equipment

Any used or older testers or simulator test equipment.

outlet

- a. A receptacle that is connected to a power supply and equipped with a socket for a plug.
- b. A point on a wiring system at which current is taken to supply utilization equipment.

output protection

Structures, devices or networks connected at the output terminals of an item to prevent electrostatic discharge damage.

overshoot

As applied to a square wave, is the initial transient response that exceeds the steady-state response.

oxide punch-through

Dielectric breakdown of an oxide layer, as in a semiconductor device.

passive components

Elements or single units such as resistors, capacitors and inductors which do not change their basic character when an electrical signal is applied.

passive ionizer

A device, usually a sharp grounded needle point, that discharges surfaces in the immediate vicinity by creating a conductive path of air ions.

peak current

The highest amplitude of a current waveform.

peak offset voltage

For pulsed ionizers, the maximum value of the offset voltage for each polarity, as the ionizer cycles between positive and negative ion outputs.

peak value

The highest amplitude of a waveform.

periodic verification

See compliance (periodic) verification.

personnel charge accumulation

Charge that accumulates on a person as a result of movement, such as walking across a floor.

personnel charge decay time

The time required for the voltage on a person to decay from a initial value to some predetermined level under specified conditions through a given floor material and footwear combination.

personnel grounding device

An electrostatic discharge protective device designed to ground any electrostatic charge accumulated on a person. NOTE: The resistance to ground of a personnel-grounding device must be high enough to avoid causing an electrical shock hazard.

planar material

An item with a surface sufficiently large and flat to conform to the surface of the electrode(s) used to measure the electrical properties of the material.

point-to-point resistance

The resistance in ohms measured between two electrodes placed on any surface.

point-to-point resistance, garments

The resistance in ohms measured from one point to another on the surface of the same panel or two different panels of a garment.

positive clamp socket

A zero insertion force (ZIF) socket with a clamping mechanism.

powered state

A powered state is a state in which all operating power supplies and grounds are supplied to the CUT. For testing purposes, the powered state should be a defined state that would be normal for the final application and in compliance with CUT defined operating parameters. In a powered state, however, there are no signals being supplied to the signal or clock pins.

preconditioning

The process of changing the input states of a device and applying appropriate electrical signals until a particular desired functional state is achieved.

pulse generation circuit

The circuit network that produces a particular discharge current waveform.

pulse width

The time interval between the points on the leading and trailing edges at which the instantaneous value bears a specified relation to the amplitude value of the pulse.

receptacle

A contact device installed at the outlet for the connection of an attachment plug.

resistance range

User-specified upper and lower resistance values which define the user-acceptable resistance values of a wrist strap or wrist strap system.

resistance to ground

The resistance in ohms measured between a single electrode placed on a surface and ground.

resistance to groundable point

The resistance in ohms measured between a single electrode placed on a surface and a groundable point.

RF pin pairs (RFPP)

Specialized high frequency radio frequency pins that are connected together as a pair of pins.

ringing

High frequency oscillation superimposed on the waveform.

rise time

The time interval of the leading edge of a pulse between the 10% and 90% points of its amplitude.

room ionization

ionization systems that provide large area coverage with air ions.

safe operation area (SOA)

The current and voltage regime where a device is in normal operation without degradation.

second breakdown

A condition where a negative resistance state occurs in a device due to thermal processes. This is designated as the voltage trigger point V_{t2} and current I_{t2} . This is typically observed after electrical breakdown (e.g., V_{t1} , I_{t1}).

service equipment

The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.

settling time

The time interval between the overshoot peak and the plateau voltage or current value plus 3% of that value.

short module

A 14-pin plastic package with all pins internally shorted together, except for pins 1 or 14, depending on the module.

shorted I/O pin

This pin is any I/O pin that is metallurgically connected (1.0 ohm) on the chip or within the package to another I/O pin (or a set of I/O pins).

shunting bar

A device that shorts together the terminals of an electrostatic discharge susceptible item forming an equipotential surface.

signal pins

Any connected pin that does not supply power or ground to the component.

sleeve-to-sleeve resistance

The resistance in ohms measured from the sleeve opening of the garment to the other sleeve opening of the same garment.

slew rate

The maximum rate of change of a voltage signal. It is expressed in units of voltage per unit time.

socketed device model (SDM) electrostatic discharge (ESD)

An ESD stress model that approximates the discharge event that occurs as the total charge stored in the test system, consisting of the IC component, socket and test simulator's parasitic elements, discharges to another object at a lower electrostatic potential (ground), through the test system relay matrix. (This model attempts to duplicate a CDM discharge for a charged component that is in a socket on a test fixture board of a relay matrix based tester.)

socketed device model (SDM) electrostatic discharge (ESD) tester

Equipment that simulates the component level SDM ESD event in a socket.

socketed discharge

An ESD event is initiated by a relay. The relay is connected to the component pin via a single pogo pin and a trace on the test fixture board while the component is placed in a socket.

spark

An electrical discharge of very short duration, normally between two conductors separated by a gas.

special signal pin pairs (SSPP)

Some specialized pins are connected together as a pair of pins. For example, XTAL or LVDSOUT IO pairs are differential type IO pairs.

spurious current pulses

Small machine model (MM) shaped pulses that follow the main pulse and should be less than 15% of I_{p1} and I_{pr} .

standard (S)

A precise statement of a set of requirements to be satisfied by a material, product, system or process that also specifies the procedures for determining whether each of the requirements is satisfied.

standard practice (SP)

A procedure for performing one or more operations or functions that may or may not yield a test result. Note, if a test result is obtained it is not reproducible.

standard static latch-up

Pulsed injection on signal pins (I-Test) and overvoltage on supply pins.

standard test method (STM)

A definitive procedure for the identification, measurement and evaluation of one or more qualities, characteristics or properties of a material, product, system or process that yield a **reproducible test** results.

static control

- a. adjective - electrostatic discharge protective.
- b. noun - Generic term for measures taken to diminish the effects of electrostatic discharge.

static control floor material

A permanently installed floor material such as tile, carpet, polymer, epoxy, or sheet flooring that dissipates static charges by grounding personnel, equipment, or other objects contacting the floor material or that controls the generation and accumulation of static charges associated with floor materials.

static control floor finish

A non-permanent coating periodically applied to existing floor surfaces that dissipates static charges by grounding personnel, equipment, or other objects contacting the floor finish or that controls the generation and accumulation of static charges associated with floor materials.

static control floor mat

A movable island of material placed over existing flooring that dissipates static charges by grounding personnel, equipment, or other objects contacting the floor material or that controls the generation and accumulation of static charges associated with the material.

static control footwear (other devices)

Devices (excluding shoes) connected to human feet such as a foot straps, toe grounders, booties, or other electro-mechanical connectors, that are intended to control the accumulation of static charge when used in conjunction with a static control floor, floor finish, or mat.

static control footwear (shoes)

Covering for the human foot that have properties to control the accumulation of static charge when used in conjunction with a static control floor or floor finish, or floor mat.

static control garment

A garment that exhibits a specified electrical resistance from any point or panel on the garment, to another point or panel on the garments.

static control seating

Chairs used in conjunction with a static control floor or static control floor mat that are intended to control the generation, accumulation and dissipation of electrostatic charge associated with the seating.

static decay test

A procedure in which an item is first charged to a specified voltage, then allowed to dissipate to a specified voltage while measuring the duration of the discharge.

static dissipative

A property of a material having a surface resistivity of at least 1×10^5 ohms/square or 1×10^4 ohm-cm volume resistivity but less than 1×10^{12} ohms/square surface resistivity or 1×10^{11} ohm-cm volume resistivity.

static electricity

See electrostatic charge.

static parameters

Static parameters are those measured with the component in a non-operating condition. These may include, but are not limited to: input leakage current, input breakdown voltage, output high and low voltages, output drive current, and supply current.

static state

Any operational state of the device where no changes are taking place. All outputs, I/O and inputs are unchanging, no internal nodes are switching. In the static state, the supply current should be constant.

static state – clocked

Allows some clocks or other internal circuits (like PLL) to operate without outside influence but inputs, I/O and outputs are generally unchanging.

step stress test hardening

A process whereby a component subjected to increasing electrostatic discharge voltage stress is able to withstand higher stress levels than a similar component stressed at a single lower voltage level.

step stress testing

A test consisting of increasing stress levels applied sequentially to a sample for periods of equal duration.

strain relief

A construction feature designed to protect the connections and the cord from premature failure.

stress current limit ($I_{\text{STRESSMAX}}$)

The negative-going supply stress is progressively stepped by incrementing the voltage amplitude of the 20us pulse, but the current can be independently limited by setting the current limit on the TLU amplifier. A good initial setting for most devices would be 1.50 amperes. If latch-up is not created using this limit, increase this to 3.0 amperes.

stress Level

The measured quantity of the transient stimulus that is being varied during testing.

supply current

The current flowing into the supply pin(s).

supply / ground current (I_{DD} / I_{SS})

The *supply currents* are the current flowing into or out of the *supply pin(s)*. Typically, power ground pins are treated as supply pins.

For CMOS devices, the positive *supply current* is typically called I_{DD} , and the *ground current* flowing out of the ground pin is often called I_{SS} . For bipolar devices, I_{CC} is used for the more positive supply current and I_{EE} for more negative supply current. Sometimes, the ground current is called I_{GND} .

supply pin (set)

A pin or set of pins on the device, which power just one section of the device.

supply voltage source

The DC source that powers the supply pins.

surface resistance

The ratio of DC voltage to the current flowing between two electrodes of specified configuration that contact the same side of a material. This measurement is expressed in ohms.

surface resistivity

For electric current flowing across a surface, the ratio of DC voltage drop per unit length to the surface current per unit width. In effect, the surface resistivity is the resistance between two opposite sides of a square and is independent of the size of the square or its dimensional units. Surface resistivity is expressed in ohms/square.

system characteristics

Signal response of the measurement chain from target or current sensor to the oscilloscope.

tabletop ionization

See worksurface ionization.

target

A current transducer used to measure cable discharge currents flowing into a defined target ground plane.

target adapter

An adapter used to connect reference pulse source cables to the current sensor and maintain the 50 ohm coaxial environment for verification of the metrology system.

target ground plane

A flat conductive surface whose potential is used as a common reference.

t_d

The time duration of the first positive half cycle of the current waveform measured between the first time the current waveform crosses the current axis and the second time the waveform crosses the current axis.

technical report (TR)

A collection of technical data or test results published as an informational reference on a specific material, system or process.

test fixture board (TFB)

The board with a socket mounted on it that electrically connects the socket to the SDM tester.

test point

A test point is the location on the test circuit board where the test current is injected. If the stress will be applied with an ESD gun an ideal test point is a through-plated via into which the contact discharge tip of the ESD gun can be inserted. If the stress will be applied with a 50 ohm IEC source the test point is a coaxial 50 ohm connector.

tester channel pin

An electrical signal pin built into an ESD simulator that electrically connects the high voltage (HV), ground or floating voltage potentials from the ESD simulator to either a single pin or a group of pins placed on the test fixture board. For example, a 512-pin ESD simulator has 512 tester channel pins.

tester channels

The direct communication between the ESD simulator and the pin under test (PUT) is provided by a set of relay signals or wiring paths that transfers the voltages and currents from the simulator to the PUT during the ESD test and measurement sequences.

thermal instability

The condition whereby a device is in a negative resistance regime due to thermal processes.

time domain reflectometer (TDR) method

A TLP methodology that uses an oscilloscope to measure both the incident and the reflected waves from the device under test (DUT).

time domain transmission (TDT) method

A TLP methodology that uses an oscilloscope to measure the transmitted wave after the device under test (DUT).

time domain transmission and reflection (TDRT) method

A TLP methodology that incorporates both the transmitted and reflected waves.

topical antistat

An antistat that is applied to the surface of a material for the purpose of making the surface static dissipative or to reduce triboelectric charging.

 t_r

The rise time of the first peak current I_{p1} measured between the times 10% and of 90% of I_{p1} .

transfer impedance

The measured output voltage from the target divided by a known input current injected into the target.

transient pulse amplitude

The amplitude of the transient stimulus measured in volts (V).

transient pulse width

The time duration that the transient stimulus is present; expressed in units of seconds (s).

transient stimulus

A temporary AC signal superimposed upon the normal DC signal of the supply voltage source.

transmission line

A coaxial cable with controlled impedance for transferring a signal with minimum loss from one point of the system to another.

transmission line pulse (TLP)

A rectangular current pulse formed by discharging a charged transmission line cable. In this document, TLP refers to any rectangular pulse formed from any pulse source.

transmission line pulse test system

A test system that applies a rectangular pulse to a device under test and allows measurement of device electrical characteristics during a pulsed state. The system typically measures current and voltage across the device, as well as leakage current after TLP pulse application.

triboelectric charging

The generation of electrostatic charges when two materials make contact or are rubbed together, then separated. *See also* triboelectric series.

triboelectric series

A list of materials arranged so that one can become positively charged when separated from one farther down the list, or negatively charged when separated from one farther up the list. Note: The series' main utility is to indicate likely resultant charge polarities after triboelectric generation. However, this series is derived from specially prepared and cleaned materials tested in very controlled conditions. In everyday circumstances, materials reasonably close to one another in the series can produce charge polarities opposite to that expected. This series is only a guide.

trigger

A transient stimulus used to initiate latch up in a device.

trigger voltage

The minimum amplitude of the transient pulse.

tri-state

A pin is in a high impedance state such that it is neither logical low or high.

t_z

The duration time of the SDM pulse width measured at 75% of I_{p1} .

unpowered state

In an unpowered state the ground pins are grounded but all power supply and signal pins are left open (floating).

unprotected area (UPA)

Any area outside an electrostatic discharge protected area.

$V_{DD\ MAX}$ (operating)

This value listed in the device data sheets as the maximum, operating voltage for which the device will still meet all specifications. It is not the same as the absolute maximum voltage allowed without causing permanent damage.

$V_{DD\ NOMINAL}$

The typical voltage supplied to the device.

vector

The digital pattern applied to a group of input pins at one time.

vector file

A program, or an input file to a program, that contains a list of many vectors used to determine the sequence of the changes required on the input pins to achieve the desired functional state.

vertical laminar flow

Non-turbulent airflow in a vertical direction.

very fast transmission line pulse (VF-TLP)

A rectangular current pulse formed by discharging a charged transmission line cable. In this document, VF-TLP refers to any rectangular pulse formed from any pulse source with a fast rise time and short pulse width.

very fast transmission line pulse test system

A test system that applies a rectangular pulse to a device under test and allows measurement of device electrical characteristics during a pulsed state. The system typically measures current and voltage across the device, as well as leakage current after VF-TLP pulse application.

V_{IH}

The voltage that is used to bias a digital input pin to logical High "1".

V_{IL}

The voltage that is used to bias a digital input pin to logical Low "0".

voltage suppression

Reduction of the voltage (V) of a charged object by increasing its capacitance (C) rather than by decreasing its charge (Q), in accordance with the formula $V = Q/C$. Note: Voltage suppression typically occurs when a charged object is brought closer to ground.

volume resistance

The ratio of the DC voltage to current passing between two electrodes, of a specified configuration, that contact opposite sides of the material or object under test. Volume resistance is reported in ohms.

volume resistivity

The ratio of the DC voltage per unit thickness to the amount of current per unit area passing through a material. Volume resistivity is given in ohm-centimeters.

worksurface ionization

Ionization devices or systems used to control static charges at a workstation. Note: This type includes bench top ionizers, overhead worksurface ionizers, and laminar flow hood ionizers.

worksurfaces groundable point

A point on the Worksurface that is intended to accommodate an electrical connection from the worksurface to an appropriate electrical ground.

wrist strap

An assembled device consisting of a wrist cuff and ground cord that provides electrical connection of a person's skin to ground.

wrist strap system

A wrist strap when properly worn by a person, where the electrical path includes the person, the cuff, and the ground cord.

Wunsch-Bell model

A model for the thermal failure of semiconductor junctions in which the thickness of the junction is assumed to be negligible and the temperature rise is limited by diffusion of heat away from the junction.

zap (*colloquial term*)

See electrostatic discharge.

4.0 INDEX

AC equipment ground.....	1	cuff	5
acceptance equipment.....	1	current limiting resistance.....	5
acceptance testing	1	current sense resistor	5
active components	1	current sensor	5
air conductivity	1	current source method.....	5
air ions	2	data sheet parameters.....	5
air ionizer.....	2	DC resistance	5
amplitude.....	2	decay rate	5
ankle strap.....	2	decay time	5
antistat, agent	2	delay line.....	6
antistatic	2	destructive damage	6
attenuator	2	device	6
automated handling equipment (AHE)	2	device path	6
auxiliary ground.....	2	device under test (DUT)	6
bandwidth.....	2	di/dt	6
barrier strip.....	2	dielectric	6
bipolar ionizer	2	dielectric breakdown voltage	6
body contacting mechanism (BCM)	2	dielectric strength.....	6
bond or bonding	2	discharge current.....	6
bonding conductor	2	discharge time.....	6
breakaway force.....	3	discrete component.....	6
bus bar.....	3	dissipative floor material	6
bypass capacitor	3	dissipative materials	6
cable discharge current	3	dynamic parameters	6
cable discharge event	3	dynamic state	7
charge decay.....	3	earth grounding electrode	7
charge induction.....	3	electric charge.....	7
charged device model (CDM)		electric field shielding materials	7
electrostatic discharge (ESD).....	3	electrical ionizer.....	7
charged device model (CDM)		electrical overstress (EOS).....	7
electrostatic discharge (ESD) tester	3	electrification period	7
charged plate monitor (CPM)	3	electrification time	7
coaxial resistive probe	3	electrostatic charge.....	7
coaxial transmission line.....	3	electrostatic damage	7
cold healing.....	3	electrostatic discharge (ESD).....	7
cold workstation.....	3	electrostatic discharge (ESD) control.....	7
common connection point.....	4	electrostatic discharge (ESD) ground	7
common point ground	4	electrostatic discharge (ESD) protective	7
compliance (periodic) verification	4	electrostatic discharge (ESD) protective	
compliance verification (periodic testing)		symbol.....	8
equipment.....	4	electrostatic discharge (ESD) protective	
component	4	workstation	8
component failure	4	electrostatic discharge (ESD) protective	
component under test (CUT).....	4	worksurface	8
compressed gas ionizer.....	4	electrostatic discharge sensitivity (ESDS).....	8
conductive flooring material	4	electrostatic discharge (ESD) shield	8
conductive material, resistance.....	4	electrostatic discharge (ESD) spark	
conductive material, resistivity	4	testing.....	8
conductivity.....	4	electrostatic discharge susceptibility	
constant area and force electrode (CAFÉ)....	4	(ESDS)	8
contact-mode discharge	5	electrostatic discharge susceptibility	
contact-mode, non-socketed discharge	5	(ESDS) classification	8
corona.....	5	electrostatic discharge susceptibility	
correlation sample.....	5	(ESDS) symbol.....	8
critical path components	5		

electrostatic discharge susceptible (ESDS) item.....	8	horizontal laminar flow.....	12
electrostatic discharge (ESD) withstand voltage.....	8	hot work station.....	12
electrostatic field.....	8	human body model (HBM) electrostatic discharge (ESD).....	12
electrostatic potential.....	8	human body model (HBM) electrostatic discharge (ESD) tester.....	12
electrostatic shield.....	8	impedance, symbol Z.....	12
electrostatics.....	8	inductive charging.....	12
emitter.....	9	initial test voltage.....	12
energized.....	9	input protection.....	12
EOS.....	9	insulated conductor.....	13
equipment grounding conductor.....	9	insulative materials.....	13
equipotential.....	9	interface board.....	13
ESD.....	9	in-use (system) resistance test.....	13
ESD event.....	9	ionization.....	13
ESD grounding / bonding reference point.....	9	ionizer.....	13
ESD protected area (EPA).....	9	isolated conductor.....	13
ESD target.....	9	isolated ground.....	13
ESD target adapter.....	9	isolated ground receptacle.....	13
ESD technical elements.....	9	junction damage.....	13
ESDS.....	9	laboratory evaluation equipment.....	13
evaluation testing.....	9	laminar flow hood ionization.....	13
failure threshold current.....	9	latch-up.....	13
faraday cage.....	10	latent failure.....	14
field induced charging.....	10	level 2 technical elements.....	14
field plate (FP).....	10	I_{p1} and I_{p2}	14
final test voltage.....	10	I_{PR}	14
floor contacting surface (FCS).....	10	I_r	14
flooring / foot grounder system resistance.....	10	machine model (MM) electrostatic discharge (ESD).....	14
foot grounder.....	10	machine model (MM) electrostatic discharge (ESD) tester.....	14
foot grounder system.....	10	main bonding jumper.....	14
functional state.....	10	minority carrier flood.....	14
functional testing.....	10	neutralize.....	14
FWHM.....	10	new equipment.....	14
garment system.....	10	no connect (NC) pin.....	14
ground.....	10	nominal supply current (I_{DDNOM}).....	14
ground cord.....	10	non-contact mode discharge.....	14
ground current.....	11	nuclear ionizer.....	14
ground fault circuit interrupter.....	11	offset voltage.....	15
ground lead.....	11	old equipment.....	15
ground pin.....	11	outlet.....	15
ground plane (GP).....	11	output protection.....	15
ground reference point.....	11	overshoot.....	15
ground strap.....	11	oxide punch-through.....	15
groundable point.....	11	passive components.....	15
groundable point, floor material.....	11	passive ionizer.....	15
groundable point, seating.....	11	peak current.....	15
groundable static control garment.....	11	peak offset voltage.....	15
groundable static control garment system.....	11	peak value.....	15
grounded.....	11	periodic verification.....	15
grounded conductor.....	12	personnel charge accumulation.....	15
grounding conductor.....	12	personnel charge decay time.....	15
grounding electrode conductor.....	12	personnel grounding device.....	15
grounding resistance.....	12	planar material.....	16
hard ground.....	12	point-to-point resistance.....	16
hardboard (standard or tempered).....	12	point-to-point resistance, garments.....	16

positive clamp socket	16	supply voltage source	20
powered state	16	surface resistance	20
preconditioning	16	surface resistivity	20
pulse generation circuit	16	system characteristics	20
pulse width	16	tabletop ionization	20
receptacle	16	target	20
resistance range	16	target adapter	20
resistance to ground	16	target ground plane	20
resistance to groundable point	16	t_d	20
RF pin pairs (RFPP)	16	technical report (TR)	20
ringing	16	test fixture board (TFB)	21
rise time	16	test point	21
room ionization	17	tester channel pin	21
safe operation area (SOA)	17	tester channels	21
second breakdown	17	thermal instability	21
service equipment	17	time domain reflectometer (TDR) method ...	21
settling time	17	time domain transmission (TDT) method ...	21
short module	17	time domain transmission and reflection (TDRT) method	21
shorted I/O pin	17	topical antistat	21
shunting bar	17	t_r	21
signal pins	17	transfer impedance	21
sleeve-to-sleeve resistance	17	transient pulse amplitude	21
slew rate	17	transient pulse width	21
socketed device model (SDM) electrostatic discharge (ESD)	17	transient stimulus	21
socketed device model (SDM) electrostatic discharge (ESD) tester	17	transmission line	22
socketed discharge	17	transmission line pulse (TLP)	22
spark	18	transmission line pulse test system	22
special signal pin pairs (SSPP)	18	triboelectric charging	22
spurious current pulses	18	triboelectric series	22
standard (S)	18	trigger	22
standard practice (SP)	18	trigger voltage	22
standard static latch-up	18	tri-state	22
standard test method (STM)	18	t_z	22
static control	18	unpowered state	22
static control floor material	18	unprotected area (UPA)	22
static control floor finish	18	$V_{DD\ MAX}$ (operating)	22
static control floor mat	18	$V_{DD\ NOMINAL}$	22
static control footwear (other devices)	18	vector	22
static control footwear (shoes)	19	vector file	23
static control garments	19	vertical laminar flow	23
static control seating	19	very fast transmission line pulse (VF- TLP)	23
static decay test	19	very fast transmission line pulse test system	23
static dissipative	19	V_{ih}	23
static electricity	19	V_{iL}	23
static parameters	19	voltage suppression	23
static state	19	volume resistance	23
static state - clocked	19	volume resistivity	23
step stress test hardening	19	worksurface ionization	23
step stress testing	19	worksurfaces groundable point	23
strain relief	19	wrist strap	23
stress current limit ($I_{STRESSMAX}$)	19	wrist strap system	23
stress level	20	Wunsch-bell model	24
supply current	20	zap (colloquial term)	24
supply / ground current (I_{DD} / I_{SS})	20		
supply pin (set)	20		